Empowering students' critical thinking skills through Remap

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Empowering students' critical thinking skills through Remap NHT in biology classroom

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Abstract

Some of the reasons of the failure biology learning were the low students' prior knowledge and reading interest. Biology learning strategies also has not empowered the students' critical thinking skills yet, which affected the low of cognitive learning outcomes. The learning model was required to increase students' reading interest and to empower critical thinking skills. Learning model that considered able to solve this problem is a model that combines reading, constructing concept maps, and the implementation cooperative learning Numbered Heads Together (Remap NHT) in the classroom. This study quasi experimental research compared the effect of Remap NHT model and traditional learning in biology classroom to empower critical thinking skills at X^{th} grade students of high school in Malang, Indonesia. The results showed that the implementation of Remap NHT during biology classroom showed the effect on students' critical thinking skills.

Key words: concept map, critical thinking skill, learning model, number head together, reading

Introduction

In this 21st century, education is confronted with the knowledge era requires a range of intellectual capitals that needs to be owned by the students. The intellectual capitals became the driving issues of the improvement at all pathways and levels of education sectors to prepare the students. Those intellectual capitals are abilities such as ability to gather information, to regulate and use information, to evaluate quality and relevance of information, and to produce accurate information supported by references (PRRC, 2010). The 21st century also required a new paradigm in the learning process (Tan, 2003) including the biology lesson. Sidi (2001) stated that the paradigm must change from teaching to learning or from teacher-centered to student-centered learning. Therefore, learning should be designed in the form of active learning environment, collaborative, self-regulated and self-directed learning (Tan, 2003). Tan (2004) explained that in the learning process, students should have the self-regulation as a key to improve the thinking ability. Students who previously passive in classroom is expected to be more active to collect a variety of information. The implementation of learning using critical thinking skills in the classroom is one of the effective ways because it can develop some skills of students, such as increasing the concentration, having a deep analysis capabilities, and improving students' learning (NEA, 2012)

Duch et al. (1999) explained that some of the competencies required for success include the ability to (1) think critically, analyze, and solve the real world problems, (2) find, to evaluate, and to use appropriate learning resources, (3) cooperate in teams and small groups, (4) oral and written communication skills effectively, and (5) use of content knowledge and intellectual skills to be a continuous learner. Similarly with Trilling & Hood (1999) stated that some of the skills that must be possessed in the era of knowledge includes: (1) critical thinking skills and hard work, (2) creativity, (3) collaboration, (4) cross-cultural understanding, (5) communication, (6) computing, and (7) career and independence.

One of the skills that have not been empowered yet in biology learning at all levels of education in Indonesia including high school was critical thinking skill. As stated by Sanjaya (2008) students seem less encouraged to develop thinking skills, but more guided to memorize information, and forced to recall the information without understand the information and connected with daily life. Trilling and Fadel (2009) defines critical thinking is the ability to analyze, interpret, evaluate, summarize, and gather information. Through critical thinking students are expected to have the ability to make effective reasons, use a thinking system, create and make decisions, and be able to solve the problems.

Critical thinking skills were the cognitive skills associated with the mind (Cotrell, 2005). Cognitive skills were the cores of critical thinking skills include interpretation, analysis, evaluation, inference, explanation, and self-regulation (Facione, 2010). According to Kauchak & Eggen (2007), metacognition, critical thinking, and content knowledge or understanding of the topics were the elements that related to each other in learning process. Corebima (2006) stated that there was a relationship between critical thinking skills with high thinking skills and metacognitive skills. It means that metacognitive skills supports higher thinking and critical thinking skills. Science is a great manner to learn using critical thinking skills because it can train the scientific way of thinking (Schafersman, 1991). The scientific methods usually used in science to make questions, gather information, develop question, do the test, analyze data, and communicate results. There are several ways to assess the students' critical thinking skills in the

classroom such as a pretest and posttest, case studies, story-telling, giving questions, role playing, and debate (Brookfield, 1997; Scott, 2009).

Student Centered Learning to Empower Critical Thinking Skill

The empowerment of students' critical thinking skills is very important for students to look at and face the various problems that will present in their life, and were able to apply in different situations. Teachers should help to empower students' critical thinking skills through the application of student-centered learning model on a various subjects including biology. The results of previous studies reported that the critical thinking skills were affected by learning strategies or models (Arnyana, 2004; Andayani 2008; Warouw 2008; Muhfahroyin 2009; & Maasawet, 2009).

The Low Students' Reading Interest

The failure of the implementation of student-centered learning in biology classroom all this time was generally caused by a lack of prior knowledge of the students regarding to the learning material. Yamin (2008) suggested that students should have the prior knowledge that would be the basic for building further knowledge. The lack of prior knowledge of students due to the low of students' reading interest on the subject matter before learning in the classroom. Corebima (2009) reported that almost all students did not read the course material and it was affected the strategy or learning model designed difficult to apply and the students' comprehension become low.

The observations results conducted by researchers in Malang, Indonesia, showed that the students' reading interest still low because only two of 27 students who visited the library frequently to read and generally students were reading the fiction books rather than textbooks. The research related to reading were also done by researchers as follows described. Prasmala (2014) found in the science X^{th} grade students in SMA Surya Buana Malang that were given the task to answer the questions using cognitive levels C1 and C2, but the students rarely read and understand the biology subject to find the answers on worksheets. Ratnawati (2015) declared that the science X^{th} grade students in SMAN 2 Malang was known more prefer playing gadgets and watching television rather than reading. Those fa[12] showed that students' reading interest were still low. Those results were not much different with the International Association for the Evaluation of Education Achievement (IAEEA) (2011) that from 49 countries to participate in a survey about the achievement of reading, Indonesia was ranked at 42 with a score of 428 and included quite low category because the average score was 500.

The low of reading interest of Indonesian students could have an impact on students' thinking skills, including critical thinking skills. Widuroyekti (2006) stated that the reading activity is a way to develop thinking ability. Thyer (2013) stated that students can perform activities such as reading and writing to develop critical thinking skills. Critical thinking skills are helpful in reading activities for students because it can change passive to active students. By reading, students would also acquire the knowledge related to scholastic success and as a source of pleasure (Wanjari& Mahakulkar, 2011). Mehrangiz (2013) and Blakey (1990) stated that

reading was also proven to empower students' metacognition skills.

Remap NHT Learning to Empower Students' Critical Thinking Skill and Reading Interest

The learning model that considered to be overcome those problems is a learning model that combines reading and drawing up a concept map activity as known as Remap before the lesson, and applying the cooperative learning models in the classroom (**Remap coople**) (Zubaidah, 2014; Pangestuti et al. 2015). Through those activities, students are expected to read the course material before lesson processes in the class. There are five elements of cooperative learning model that were applied to achieve maximum results, including positive interdependence, individual responsibility, face to face, communication, and the group evaluation process (Lie, 2002). At the end of the learning process, students are requested to complete the concept map that were created before. Patrick (2011) stated that the concept maps help students improve and summarize the course material.

The cooperative learning model could be combined with Remap is Numbered Heads Together (NHT) so that the learning model was called Remap NHT. The learning steps of NHT were numbering, questioning, thinking together, and answering (Arends, 2009). In NHT learning, teachers check students' understanding from reading activity of students by using questions. Maasawet (2009) stated that NHT has several advantages that each student be ready, can conduct discussions in earnest, and students with higher academic level could teach the students with the lower academic level. Winarni (2011) found that the implementation of NHT could improve cognitive learning outcomes of science. NHT learning models can indirectly make students share information, be a good listener, and able to speak with full consideration. When teacher choice any students to answer questions, the students did not know who would be selected so that there will be a sense of responsibility to each student. Good students will not dominate the group and expected that all students become more tolerant (Kagan, 2007; Munawaroh, 2015).

Another Remap coople learning model have proved to improve the metacognitive skills, critical thinking skills, and cognitive learning outcomes of students such as those researches describe as below. Setiawan (2015) stated that implication of Remap TPS could increase interest in reading and metacognitive skills of students. Antika (2015) also stated that application of biology learning Remap STAD can enhance metacognitive skills and student learning outcomes. Pangestuti (2014) showed that the application of biology-based learning Remap Teams Games Tournament (TGT) model increased reading interest, critical thinking skills, metacognitive, and cognitive learning outcomes biology students. Hasan (2014) showed that the implementation of Remap Students Team Achievement Division (STAD) learning model could increase reading interest, critical thinking skills, metacognitive, and cognitive biology achievement of students.

The results of this study are expected to provide the information for teachers and policy makers related to another learning model that can empower students 'critical thinking skills and also increase reading interest of students. By increasing reading interest of students including reading the course material before the class, learning strategies or models that have been designed by teacher are expected can be implemented because students have the prior knowledge related to

the subject matter. It will also have an impact on improving the quality of learning overall.

Materials and Methods

This study was the quasi experiment designed to examine the empowerment of critical thinking skills of students in biology classroom taught by Remap NHT with traditional learning. The research was pretest-posttest control group design (Fraenkel & Wallen, 2009).

The sample in this study consisted of 50 students of the first year class in senior high school in Malang, Indonesia. Determination of class research sample was conducted by random sampling. Each learning model was represented by Remap NHT and traditional classes. The classes previously tested by equity test were use a national test scores. Analysis of the equity performed used t-test by SPSS 17.0 for Windows.

The research instruments developed by the researchers include the treatment and measurement instruments. Treatment instrument consisted of a syllabus, lesson plans, test questions, and worksheets. Students' critical thinking skills was measured by 18 essay question test refers to Finken and Ennis (1993) that adapted by Zubaidah (2015) with a scale of 0 to 5, then converted into an interval scale of 0 to 100. The instrument previously was validated by experts and empirical validation. The validity of the instrument by experts (expert judgment) including content and construction validation. The content validity was determined by the extent to which the question items representing all subject matter. The construction validity included quality items overall instrument based on a clear definition of operational variables. The construction validity test was done by revised learning instruments based on expert suggestions. The results of the validation from the experts indicated that the instruments was valid.

Empirical validity was conducted by testing the instruments to 50 students. Test was carried out to determining the validity and reliability of the instrument. Validity refers to the extent of measuring instruments precision and accuracy in the conduct of measurement functions. The validity of an instrument related to the instrument's ability to measure the characteristics of the variables. The reliability related to the degree of test scores was free of measurement error or an index that indicates the extent to which a measuring instrument was reliable. The test results showed that the instrument was valid and reliable.

The data on students' critical thinking skills was obtained from essay questions given at the beginning and end of the lesson, and then were then analyzed using one way ANCOVA. Those data previously was tested by prerequisite test including normality data test using One Sample Kolmogorov-Smirnov and homogeneity test using the Levene's Test of Equality of Error Variance data analysis was done by using SPSS 17.0 for Windows.

Results

Critical thinking skills of students were measured by using essay test and rubric on the results of the pretest and posttest. Summary of ANCOVA test of the effect of learning models on the students 'critical thinking skills are shown at Table 1. The changes of pretest to posttest scores of students' critical thinking skills in Remap NHT and traditional learning are shown at Table 2.

Table1.The summary of analysis of covariance on students' critical thinking skills

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F Ratio	Sig.
Corrected Model	7667,618(a)	2	3833,809	76,309	,000
Intercept	5107,733	1	5107,733	101,666	,000
XCTS	841,536	1	841,536	16,750	,000
MODEL	5791,906	1	5791,906	115,284	,000
Error	2361,304	47	50,241		
Total	125120,467	50			
Corrected Total	10028,922	49			

Table 2.The changes of pretest and posttest scores of students' critical thinking skills

Model	Mean Scores of Pretest	Mean Scores of Posttest	Difference	Corrected Scores	Enhancement (%)
Traditional	30,94	36,75	5,81	32,22	18.79
Remap NHT	14,95	60,14	45,19	65,05	302.27

ANCOVA test results at Table 1 indicates that there was the differences between students' critical thinking skills were taught using Remap NHT with traditional learning ($p < 0.05$). It means that Remap NHT has the positive effect on students' critical thinking skills. The changes scores of pretest to posttest at Table 2 shows that the critical thinking skills of the students in Remap NHT increased as much as 302.27 %, while the traditional learning of only 18.79 %.

Discussion

High Improving Critical Thinkings' Score using Remap NHT

The results showed that Remap NHT model has the positive effect on students' critical thinking skills empowerment. The critical thinking skills scores change from pretest to posttest on students were taught by Remap NHT much higher than traditional learning. It was caused by the syntax of Remap NHT that consisted of reading and constructing concept maps at home, discussions through cooperative learning NHT in the classroom and the last completing their concept maps.

Improve Critical Thinking Skill by Reading Activity

In the early stages of learning biology based on Remap NHT, students were given the task to read the course material that will be taught. This task could improve the students' critical thinking skills as Thierney statement (1989) that actually the reader has the thinking skills that sometimes did not recognized or known by them self. Klimovienė (2006) stated that critical thinking skills could be used to develop the knowledge and skills of students through reading, writing, and presentation.

The reading assignment was given at the end of each lesson and done at home before next lesson. Arita (2007) explained that teachers should give students assignment to read related material for the next lesson assignments routinely. Reading is one way to increase and improve the

knowledge, broaden views, enrich the information, and stimulate the emergence of new ideas (Nurdin, 2011). Reading is a habit that needs to train the brain with the positive things as a learning process, so that students have an obligation to read in supporting learning activities.

Students would be easier to understand the material that had been learned in the classroom when they already read before, because by reading the students will have a prior knowledge. Habituation of reading will evoke the students' spirit to learn. Reading is one of study planning which can help the teacher to monitor the progress and evaluate student' learning, so that the students can change the way of learning to improve their learning outcomes by reflection process of learning. If students do not understand a concept, the students will try to find the meaning of concepts or words that are not understood, so that students will continue to read.

Improve Critical Thinking Skill by Constructing Concept Map

The next step on Remap NHT, students are required to construct a concept map. Concept maps could be used as a teachers' way to check who students have already read the material. The task of making a concept map would make students read the course material (Marzano, 1998). Through making concept maps students are expected to know the material to be studied and understand all they had learned. Through comprehend the important concept, it will facilitate students to plan and prepare the material to be learned in the classroom. Daley (2002) suggested that using the concept maps could help the students become more aware and understand their learning and make it more meaningful. Concept maps can make students remember more information and be able to use information more effectively because the information was used as a long-term memory.

The use of concept maps in learning biology generally as an alternative to effective learning if laboratory facilities and infrastructure for the implementation of the practicum are limited. The advantages of the use of concept maps in learning biology is to facilitate teachers in preparing and planning lessons, as well as the creativity of students learning more meaningful.

Improve Critical Thinking Skills by NHT

The next step in Remap NHT is the learning in the classroom using NHT cooperative learning. At this stage the teacher divides the students into groups of 3-4 students. Lie (2002) explained that the cooperative learning can make students easy to socialize and raised more pleasant learning atmosphere because as social human beings could not live without others help. Application of cooperative learning NHT expected to make students become active in expressing their opinions, develop ideas, to train students to think critically, and responsible for the group's cooperation so that students could achieve the expected competencies (Siregar, 2013). Kusumaningtyas (2013) stated that NHT had the procedures established explicitly to give students more time to think, respond, and help each other.

Klimovienė (2006) stated that cooperative learning could be used to develop students' critical thinking skills through: a) election of different group members, b) create a relationship of mutual dependence and has the same goals, so that students did not work individually and compete among members of the group, c) the position of each member at the group is same, d) the teacher

may offer assistance to students as support in finding a solution of the problem, and building a knowledge. Winarni (2011) stated that NHT not only help students to understand difficult concept of science, but also is very useful to establish cooperation and critical thinking.

The questioning stage in NHT could trained students' ability to solve the problems (Kristanti, 2013). NHT is more effective than traditional learning. NHT related to the problem solving process (Misu, 2014). Student will try to find solving problems so that students are expected to apply in everyday life by considering the benefits for the answers submitted and are accustomed to think critically. Being trained to solving problem students will adapted to use critical thinking. At "heads together" stage, students can help each other when there are group members who do not understand the course material. After that, on answering stage each group tries to show the best possible answers during class discussions. Siregar (2013) stated that the cooperation within the group with the numbering on each student was the main characteristic of NHT. All students are trying to understand the material being taught and each is responsible for a number of their members. NHT preceded by numbering that requires readiness of all students. All group members must be master the subject matter because each student has a same chance to be called by the teacher randomly.

Empower Critical Thinking Skills by Completing Concept Map

After following the NHT, students completing the concept map. Concept maps were generally used on a variety of subjects including biology that serves as a tool to help students organize information and develop higher level thinking abilities (Maas & Leauby, 2005). This opinion supported by Novak and Gowin (1984) stated that the concept maps could help students to organize information and build a better knowledge gained from new knowledge critically. Additionally, Hyerle (1996) suggested a concept map was a learning tool that illustrates the thinking of students, allowing students to organize ideas, and better in reading, writing and thinking.

Enhancing the concept maps could make the students improve and summarize the learning (Patrick, 2011). Concept maps were also effective as a learning tool to study science and to help students understand and remember the material science (Asante, 2007). Opinion was supported by Winkel (2007) stated that meaningful learning was significant if students understand the material being studied. The good understands related to the course material make students can memorize it better. Students who use concept maps obtained a higher score on the posttest than students who taught by conventional learning. Thus, the assignment in Remap NHT would provide a positive effect to increase students' cognitive abilities (Asante, 2007).

Traditional Learning didn't Adequate to Empower Critical Thinking Skill

In traditional learning, critical thinking skills are less empowered optimally. Slavin (2011) stated that traditional learning reported to be less effective in improving learning outcomes. Learning activities in traditional learning tend to be verbal (Sarbessa, 2006), unilateral (Khalid & Azeem, 2012), and dominated by teachers, and frequently asked questions that make students become passive. Traditional learning did not provide an opportunity for students to become independent learners to investigate and conduct teamwork (Kenner & Weinerman 2011).

In traditional learning, individual accountability was often overlooked (Ahmad and Mahmood 2010). so that the tasks performed only by particular members of group, while the other group members tend to be passive. In traditional learning, monitoring through observation and intervention carried out by teachers throughout the study groups take place. It did not provide an opportunity for students to exercise their creativity (Khalid & Azeem, 2012; Tsai, 2013). The assignments in traditional learning sometimes are individually thus ignoring the interpersonal relationships between students. Teachers often let students or certain groups to dominate so no collaboration and positive dependence among students in the group, and there is no interaction proportional happened.

Based on the above, this research can be valuable information for readers, especially for teachers to choose appropriate learning models that can empower students' critical thinking skills such as learning Remap NHT model.

Conclusion

Based on the results of research and discussion, it can be concluded that the Remap NHT model proven to empower students' critical thinking skills better than traditional learning in biology classroom. Students' critical thinking skills empowerment of going through the reading, constructing a concept maps on the results of readings, discussions through cooperative learning NHT, and to revise the concept map at the end of the learning.

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